PATENT ABSTRACTS OF JAPAN

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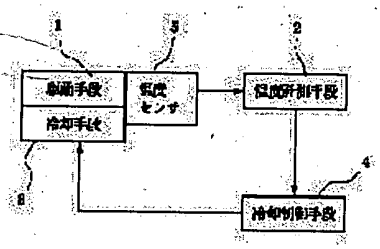
(54) DRIVING DEVICE

(57)Abstract:
PURPOSE: To more effectively avert the unfavorable effect on the alignment precision due to the heat generated by the title driving device.
CONSTITUTION: The title driving device used for a precise alignment device is provided with a driving means 1 making precise alignment, a temperature measuring means 2, 5 for measuring the temperature at least in one position of the driving means 1 or nearby position thereof, a cooling means 3 recovering the heat generated from the driving means 1 as well as a cooling control means 4 controlling the cooling down capacity of the cooling means 3 corresponding to the temperatures measured by the temperature measuring means 2, 5.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram of the driving gear concerning the 1st example of this invention.
[Drawing 2] The cooling control means of drawing 1 is the block diagram of the 2nd example of this invention which showed the example which has given the command to the cooling system which drives a cooling means.
[Drawing 3] It is a block diagram showing the operation gestalt of the driving gear concerning the 3rd example of this invention when using a refrigerant for a cooling means.
[Drawing 4] It is the block diagram in which having extracted the inside of the wavy line of drawing 3 , and having shown the example of arrangement of a temperature sensor.
[Drawing 5] It is the block diagram of the driving gear concerning the 3rd example of this invention when using a driving means as a linear motor.
[Drawing 6] It is the block diagram which expressed the 4th example of this invention in case the driving means of this invention is a multipolar linear motor, and extracted only the coil part.
[Drawing 7] It is the block diagram of the conventional driving gear.
[Description of Notations]
A driving means, the driving means of a 1a:fixed side, 1b : 1: The driving means of a movable side, 2: A thermometry means, 3:cooling means, the refrigerant by the side of 3a:supply, 3b : The refrigerant of a return end, 4: A cooling control means, 5, 5a, 5b, 5c, 5d, 5e : A temperature sensor, 6 : A cooling system, a 6a:thermoregulator, a 6b:controller, a 6c:flowmeter, 6d:flow rate command means, 10: 11:datum reference for positioning, 12:location measurement means, 13 : The die length to measure, 14: -- a controller, 15:driver, 21a, 21b and 21c, a 21d:permanent magnet, and 22: -- they are York, 23:coil, 24:coil support, 23a and 23b, a 23c:coil, 5A and 5B, and a 5C:temperature sensor.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the driving gear carried in precision pointing devices, such as an X-Y table of a semi-conductor aligner or shape-measurement equipment, and a high precision processing machine.
[0002]
[Description of the Prior Art] By the end of today when the positioning accuracy of NANOMETORU (nm) order is demanded For example, 100nm is transformed by the temperature change whose 100mm low-fever expansive additive (coefficient of thermal expansion 1x10-6) is 1 degree C. Moreover, even if change of the air temperature in the optical path of an optical interference type length measurement meter is 1 degree C or less, as for cooling of a driving gear which collects the heat emitted from a driving gear as a preventive measure of these temperature changes, it is also indispensable for a certain reason that 100nm of measured value of a location changes.
[0003] Conventionally, a driving gear generates heat in the case of a drive, and it is cooling using the refrigerant, the heat pipe, the Peltier device, etc. in the precise positioning device in order to bring about the air fluctuation from which the generation of heat becomes heat deformation of the structure and the error factor of an optical interference type length measurement meter. Namely, as shown in drawing 7 , the cooling control means 3 is cooling by setting up beforehand the amount of cooling of cooling means, such as a flow rate of a refrigerant, radiator temperature of a heat pipe, and a drive current of a Peltier device, so that the equipment with which a driving gear 1 and a driving gear 1 are carried at the time of generation of heat of a driving gear (driving means) 1 may become predetermined temperature. For example, when pouring a refrigerant, a flow rate is set up greatly, or recovery heat capacity is increased using a refrigerant lower than predetermined temperature, and a driving gear or a pointing device approaches predetermined temperature at the time of a drive, and he is trying for temperature to become fixed.
[0004]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional example, since the amount of cooling beforehand set up on the basis of average calorific value at the time of a drive was always cooled, there were the following faults.

[0005] ** The calorific value of a driving gear is not fixed, and since calorific value fluctuates with the drive pattern of a driving gear, temperature changes.
[0006] ** Since the driving gear has stopped, generation of heat is minute or cooling beyond the need is performed at the time of zero, the cooling system will operate vainly.
[0007] ** When the temperature of the refrigerant used at the time of a halt of a driving gear is still lower, and when the amount of heat recovery is fixed, the temperature of a driving gear will always fall too much.
[0008] Among the above faults, things in connection with a temperature change, such as ** and especially **, brought about the structure of the perimeter of a driving gear, and the temperature change of an ambient atmosphere, and had had the bad influence on the positioning accuracy of nano meter order according to heat deformation of the structure, the measurement error of the location resulting from a temperature change, etc.
[0009] The purpose of this invention is to remove more effectively the bad influence to the positioning accuracy resulting from the heat which a driving gear emits in view of the trouble of such a conventional technique.
[0010]
[The means and operation] for solving In order to attain this purpose, the driving gear of this invention used for a precise pointing device The driving means which performs precise positioning, and a thermometry means to measure the temperature of this driving means or its near, It has a cooling means to collect the heat produced from said driving means, and the cooling control means which controls the amount of cooling of said cooling means according to the temperature acquired by said thermometry means. By this Temperature changes, such as the structure of a driving gear and the perimeter of a driving gear and an ambient atmosphere, are lessened, heat deformation of the structure and the length measurement error resulting from a temperature change are mitigated, and the positioning accuracy by the driving gear is raised.
[0011] When a cooling means is what circulates a refrigerant, a cooling control means controls the flow rate of a refrigerant. That is, when the flow rate of a refrigerant is increased, temperature is lowered, when there is much generation of heat and temperature goes up, and there is little generation of heat and temperature falls, fluctuation of temperature, such as a driving gear, the structure of the near, or an ambient atmosphere, is prevented by reducing the flow rate of a refrigerant and lessening the amount of cooling. Since refrigeration capacity increases in order that the volume of the refrigerant which flows to unit time

amount may increase and heat capacity may increase, if the flow rate of a refrigerant increases, the amount of cooling is controlled by controlling the flow rate of a refrigerant.

[0012] Moreover, since it becomes the index of the heating value in which the temperature of this refrigerant generated heat, or the temperature of a driving means when a thermometry means is what measures the temperature of the refrigerant near the driving means (for example, when the thermometry point of a thermometry means is the temperature of the refrigerant which passed the driving means), the temperature change of a driving gear etc. is prevented by making temperature of the refrigerant measured regularity.

[0013] Furthermore, a driving means is a linear motor, and since the temperature change could be immediately measured since the measure points of temperature were near, such as a coil which is a source of generation of heat, when said thermometry means is the thing of the coil of a linear motor, permanent magnets, or those near which measures the temperature of a part at least, and the source of generation of heat or its near is cooled, the amount of recovery of heat is adjusted with a sufficient precision to calorific value. Moreover, the time lag of the temperature control and cooling control by the delay of the temperature rise of a thermometry point is controlled to the minimum. Therefore, the temperature of equipment is uniformly held by optimization and efficient-izing of the amount of cooling, disturbance factors, such as an error of length measurement resulting from heat deformation or a temperature change, are mitigated, and the positioning accuracy of a driving gear improves.

[0014]

[Example]

[Example 1] drawing 1 is the block block diagram of the driving gear concerning the 1st example of this invention, and expresses the description of this invention best. The cooling control means which the driving means which performs positioning with precise 1, a thermometry means to by_which 2 measures temperature, a cooling means connect with a driving means 1, or 3 is incorporated, and collect the heat of a driving means 1, and 4 incorporate the temperature data of the thermometry means 2 in this drawing, determines the amount of cooling according to the data, and controls the cooling means 3, and 5 are temperature sensors for the thermometry means 2 to measure the temperature of a driving means 1.

[0015] A driving means 1 is for driving the candidate for positioning and positioning to a precision, when driving, heat is produced, and temperature rises. Measuring this temperature with the temperature sensor 5 arranged in a driving means 1 or its near, the thermometry means 2 sends the temperature of the driving means 1 acquired by the temperature sensor 5 as temperature data to the cooling control means 4. The cooling control means 4 determines the amount of cooling of the cooling means 3 based on the temperature data obtained from the thermometry means 2. For example, if temperature rises with time amount, the amount of cooling is increased, and if it descends, the amount of cooling will be reduced. Furthermore, the cooling means 3 cools a driving means 1 according to the amount of cooling which the cooling control means 4 determined. Since the cooling means 3 cools according to the calorific value of a driving means 1 at this time, the heating value for the cooling means 3 not to collect among the heating values which the driving means 1 emitted can be kept almost constant. Therefore, degradation of the positioning accuracy by the temperature change of heat deformation of a driving means 1 and the structure of the circumference of it or an ambient atmosphere can be prevented.

[0016] [Example 2] drawing 2 is the block diagram showing the 2nd example of this invention, 4 is a cooling control means which determines the amount of cooling based on the temperature data obtained from the thermometry means 2 like said example 1, and 6 is a cooling system which cools a driving gear 1 using the cooling means 3. A cooling system 6 cools according to the amount of cooling which the cooling control means 4 determined. In drawing 1 , to the cooling control means 4 ordering the direct cooling means 3 the amount of cooling, the cooling control means 4 takes out the command of the amount of cooling with drawing 2 to a cooling system 6, and the description is in the point that the cooling system 6 is making the cooling means 3 perform cooling according to it. For example, when pouring a refrigerant with a thermoregulator and cooling a driving gear, the cooling means 3 is a refrigerant, and it becomes the thermoregulator which pours the refrigerant of temperature with a cooling system 6 by a certain flow rate, and is applied to this example. Also in this case, it has the same effectiveness as the above-mentioned example.

[0017] [Example 3] drawing 3 is the block block diagram showing the 3rd example of this invention, and expresses the operation gestalt at the time of using a refrigerant for a cooling means. 1a and 1b are the driving means of a pair among drawing. 1a The driving means of a fixed side, The temperature sensor with which 1b had been arranged at the driving means of a movable side movable to the longitudinal direction of a drawing, and 5 has been arranged at driving means 1a or 1b, A thermometry means to output the temperature data which measured 2 with the temperature sensor 5 to the exterior, The refrigerant by the side of the supply whose 3a cools driving means 1a and 1b, the refrigerant of a return end with which 3b cools driving means 1a and 1b, The cooling control means which outputs a command signal for 4 to control the flow rate of the refrigerant which is the amount of reception cooling about temperature data from the thermometry means 2, The thermoregulator with which 6a pours the refrigerant of predetermined temperature, the controller to which 6b adjusts a refrigerant flow rate by closing motion of a bulb, accommodation of a pump output, etc., The flowmeter with which 6c measures a refrigerant flow rate, a flow rate command means to control the amounts of accommodation of controller 6b (the amount of closing motion of a bulb, output of a pump, etc.) so that the refrigerant flow rate directed by the command signal from the cooling control means 4 and the refrigerant flow rate which flowmeter 6c measured are in agreement 6d, The datum reference for [for / by which 10 was laid in movable side driving means 1b / positioning / by which 11 was laid in movable side driving means 1b / 10] positioning, A location measurement means by which 12 measures the location for [10] positioning with reference to a datum reference 11, The controller which outputs a command signal for the die length by which 13 is measured by this, and 14 to control the amount of drives of driving means 1a and 1b by the location data for [which was obtained from the location measurement means 12 / 10] positioning, 15 is

a driver which drives driving means 1a and 1b according to the command from a controller 14.
[0018] When driving means 1b moves to the longitudinal direction of a drawing to fixed driving means 1a, the candidate 10 for positioning moves in this direction, and the location for [10] positioning is measured by the location measurement means 12 on the basis of a datum reference 11. For example, a datum reference 11 is a reflective mirror, when the location measurement means 12 is a laser interferometer, die length 13 serves as the optical path length, and this serves as a location for [10] positioning. Generally, since it is separated from some of the datum reference 11 for [10] positioning, and since the location of a datum reference 11 is made into the location for [12] positioning, the distance fluctuation between these both serves as an error of positioning. A controller 14 gives a command to a driver 15 so that the candidate 10 for positioning may be positioned by the position using the location data of the location measurement means 12, and a driver 15 drives driving means 1a and 1b. If driving means 1a and 1b generate heat then, temperature tends to change. The thermometry means 2 measures this temperature using a temperature sensor 5, the cooling control means 4 adjusts the flow rate of the refrigerants 3a and 3b which thermoregulator 6a pours using controller 6b based on that result, and it is made for the temperature change of driving means 1a and 1b to be lost by this. In addition, when adjusting controller 6b, the command is issued so that the flow rate which flowmeter 6c measures to the command value of the flow rate of the cooling control means 4 in 6d of flow rate command means may reach.

[0019] If the temperature change of driving means 1b is lost, heat deformation of driving means 1b will be lost, and distance change with the datum reference 11 for [10] positioning will be lost. Therefore, since there is no distance change with the datum reference 11 for [10] positioning, it can consider that the location of the datum reference 11 which the location measurement means 12 measured is a location for [10] positioning, and the error at the time of being location measurement is lost. Moreover, if the temperature change of driving means 1a or 1b is reduced, ambient temperature, especially the temperature change of an optical path 13 to measure are prevented, and since it is avoidable to change the measured value of the location measurement means 12, the error in the case of location measurement will be lost.
[0020] Thus, since the temperature change of a driving means and its near, or an ambient atmosphere can be suppressed and fluctuation of heat deformation of the structure or air can be suppressed by measuring the temperature of a driving means, and adjusting the flow rate of a refrigerant so that a temperature change may be lost in case a driving gear is driven for positioning for positioning, positioning accuracy can be raised conventionally.
[0021] Drawing 4 is the block diagram in which having extracted the inside of the wavy line of drawing 3 , and having shown the example of arrangement of a temperature sensor. In drawing 4 , the temperature sensor with which 5 has been arranged at driving means 1b, the temperature sensor with which 5a, 5b, and 5c have been arranged at driving means 1a, the temperature sensor which is arranged 5d in the ambient atmosphere near driving means 1a or the 1b, and measures ambient temperature, and 5e are temperature sensors arranged at refrigerant 3b of a return end. A temperature sensor is arranged to any one in these arrangement locations, such as inside of driving meansa [1] and 1b or ambient atmosphere, and refrigerant 3b, or the cooling control means 4 is controlling the flow rate of a refrigerant based on the temperature of those one or more points that shot, and have arranged to two or more points, and the thermometry means 2 measured. 5d of temperature sensors is effective in order to suppress the temperature change of air, and if the change in calorific value can be guessed with the amount of the temperature rise of a refrigerant, for example, temperature rises, temperature sensor 5e can increase a flow rate, can increase the amount of cooling, and can suppress the temperature change of driving means 1a and 1b and near of those, or an ambient atmosphere.
[0022] [Example 4] drawing 5 is the block diagram (part sectional view) in which showing the 4th example of this invention and having shown another operation gestalt using the linear motor as a driving means. They are York where the permanent magnet was fixed 21a, 21b, 21c, and 21d among drawing, and, as for 22, permanent magnets 21a-21d were fixed, the coil with which, as for 23, a current flows, and the coil support which 24 supports a coil 23 and serves as passage of Refrigerants 3a and 3b. In addition, the location measurement means, the controller, the driver, etc. are not illustrating. Since a coil 23 is in the field generated with the permanent magnet 21, if a current flows in a coil 23, the Lorentz force will occur in the longitudinal direction of drawing, and it will drive relatively York 22 and the coil support 24 of each other to a longitudinal direction. When driving this linear motor, a current flows in a coil 23 and a coil 23 generates heat. A temperature sensor 5 is arranged in a coil 23 or its near, the thermometry means 2 measures the temperature, and a cooling system 6 passes refrigerant 3a of a predetermined flow rate according to the amount command of cooling of the cooling control means 4. Since this refrigerant cools directly the coil 23 and the coil support 24 which are a source of generation of heat and collects heat, it is effective in suppressing the structure of a driving gear, and the temperature change of an ambient atmosphere. The same effectiveness is acquired even if it arranges a temperature sensor 5 to the coil support 24, York 22, refrigerant 3b, etc.
[0023] [Example 5] drawing 6 is the block diagram showing the 5th example of this invention using a multipolar linear motor as a driving means, and is drawing which extracted the coil part of a linear motor. It is the temperature sensor with which 23a, 23b, and 23c had been arranged at the coil, and 5A, 5B, and 5C have been arranged at Coils 23a, 23b, and 23c, respectively. Although a temperature sensor can also be arranged to one suitable point like the case where it is the single electrode of drawing 5 since there are two or more coils in the case of a multipolar linear motor, a temperature sensor can be arranged to two or more points like drawing 6 , and the flow rate of Refrigerants 3a and 3b can also be determined based on two or more temperature which the thermometry means 2 measured. Since it differs and each temperature also differs, the current which flows in each coil can carry out weighting to each temperature, respectively, or can choose the maximum of each temperature as it, and can also control the flow rate of a refrigerant. The effectiveness as the above-mentioned example that it is the same also in a multipolar linear motor is acquired.
[0024]

[Effect of the Invention] A cooling means to perform precise positioning and to collect the heat to the driving means accompanied by generation of heat as explained above, Since a thermometry means to measure the temperature of said driving means or its near, and the cooling control means which controls the amount of cooling of said cooling means according to the temperature were established, Temperature changes, such as a driving means, the structure of the perimeter, and an ambient atmosphere, are lessened, heat deformation of the structure and the length measurement error resulting from a temperature change are mitigated, and it is effective in raising further the positioning accuracy of the nano meter order by the driving gear.

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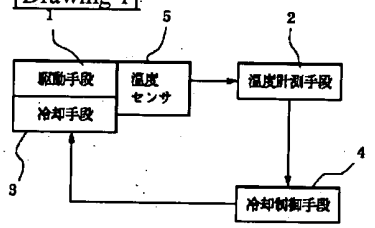
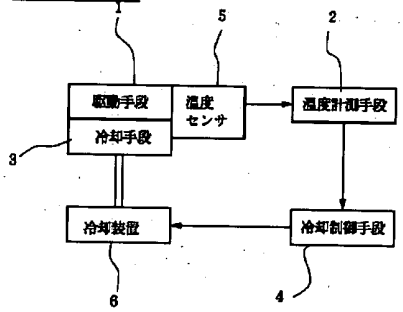
* NOTICES *

DRAWINGS

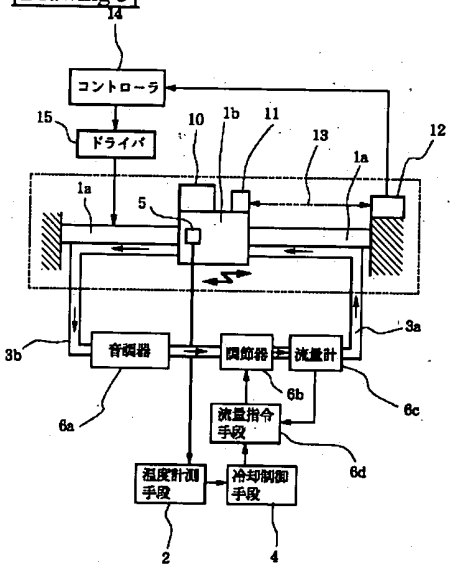
[Drawing 1]



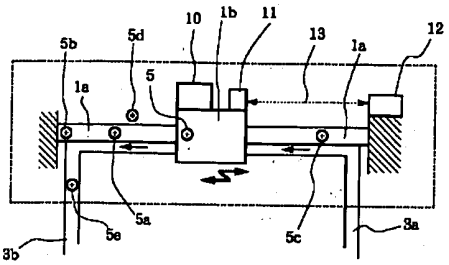
[Drawing 2]



[Drawing 3]



[Drawing 4]



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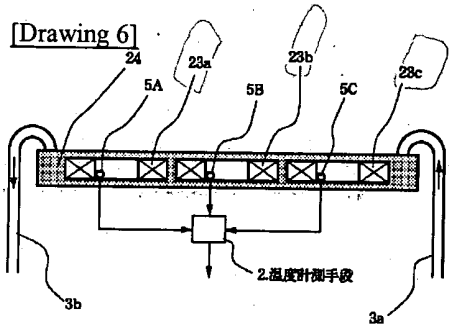
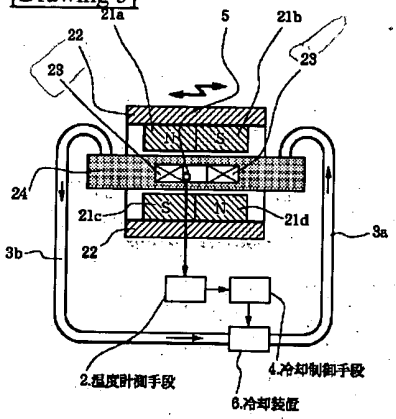
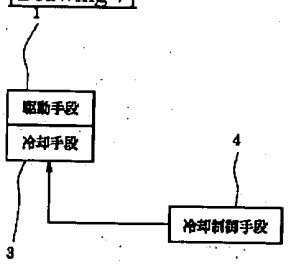


[Drawing 5]



[Drawing 7]



[Translation done.]

H01L021/027 , H01L021/68

ABSTRACTED-PUB-NO: JP 07302747A

BASIC-ABSTRACT:

The appts. consists of a driver (1) to perform precise positioning. The temperature of the driver or its surroundings (5) is measured by a thermometer (2). The heat produced in the driver is recovered by a cooling unit (3). The amount of cooling of the cooling unit is controlled by a cooling controller (4). The controller operates according to the temperature measured by the thermometer.

USE/ADVANTAGE - In e.g. X-Y coordinate table of semiconductor exposure system, shape measuring device, or high precision processing machine. Reduces errors resulting due to heat deformation. Improves positioning accuracy.

CHOSEN-DRAWING: Dwg.1/7

TITLE-TERMS: DRIVE APPARATUS PRECISION POSITION APPARATUS X=Y TABLE
SEMICONDUCTOR EXPOSE SYSTEM COOLING CONTROL CONTROL COOLING UNIT
ACCORD TEMPERATURE MEASURE THERMOMETER

ADDL-INDEXING-TERMS:
SHAPE MEASUREMENT

DERWENT-CLASS: P56 S02 T06 U11 X25

EPI-CODES: S02-A08C; T06-B02B; T06-B13; U11-C04B; U11-F02B; X25-A03F;

SECONDARY-ACC-NO:
Non-CPI Secondary Accession Numbers: N1996-023526

DERWENT-ACC-NO: 1996-027763

DERWENT-WEEK: 200125

TITLE: Drive appts. for precise positioning appts. such as X=Y table of semiconductor exposure system - has cooling controller which controls cooling unit according to temperature measured by thermometer

PATENT-ASSIGNEE: CANON KK[CANO]

PRIORITY-DATA: 1994JP-0113411 (May 2, 1994)

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